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Challenge of Utilizing Terrestrial Sequestration to Mitigate Atmospheric Carbon Emissions

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Traditionally recognized challenges (1)

- Baselines
  - Methods available for many project types nationally—e.g. 1605(b) and CA Climate Action Registry—and internationally—e.g. Clean Development Mechanism
- Permanence (or lack of)
  - Various methods exist—CCAR uses permanent easements; accounted for in 1605(b), tCERs in the CDM

Traditionally recognized challenges (2)

- Leakage-activity shifting or from market effects
  - Minimal problem under a national "cap and trade"
  - Methods developing for accounting
  - Steps known for reducing leakage potential
- Measuring and monitoring
  - Methods have existed for long time and now recognized by regulatory bodies
    - M&M protocols given in revised 1605(b) and CCAR
    - Internationally recognized in IPCC 2003 reports and methodologies for CDM projects
    - New methods developing for aboveground biomass to decrease costs using remote means with high resolution airborne imagery and sensors
    - New sensors for soil carbon monitoring

New challenges: linking terrestrial C sequestration to national issues

- Energy security
  - Biomass is the leading source of renewable energy in the United States.
  - Understanding biomass resource availability is critical for planning for both feedstock production and for development of the biomass industry (DOE web site)
- Healthy Forest Initiative
  - Launched in August, 2002 –goal to reduce the risks that severe wildfires pose to people, communities, and the environment
  - Many of today's forests have unprecedented levels of flammable materials making them at risk for uncharacteristically severe fires

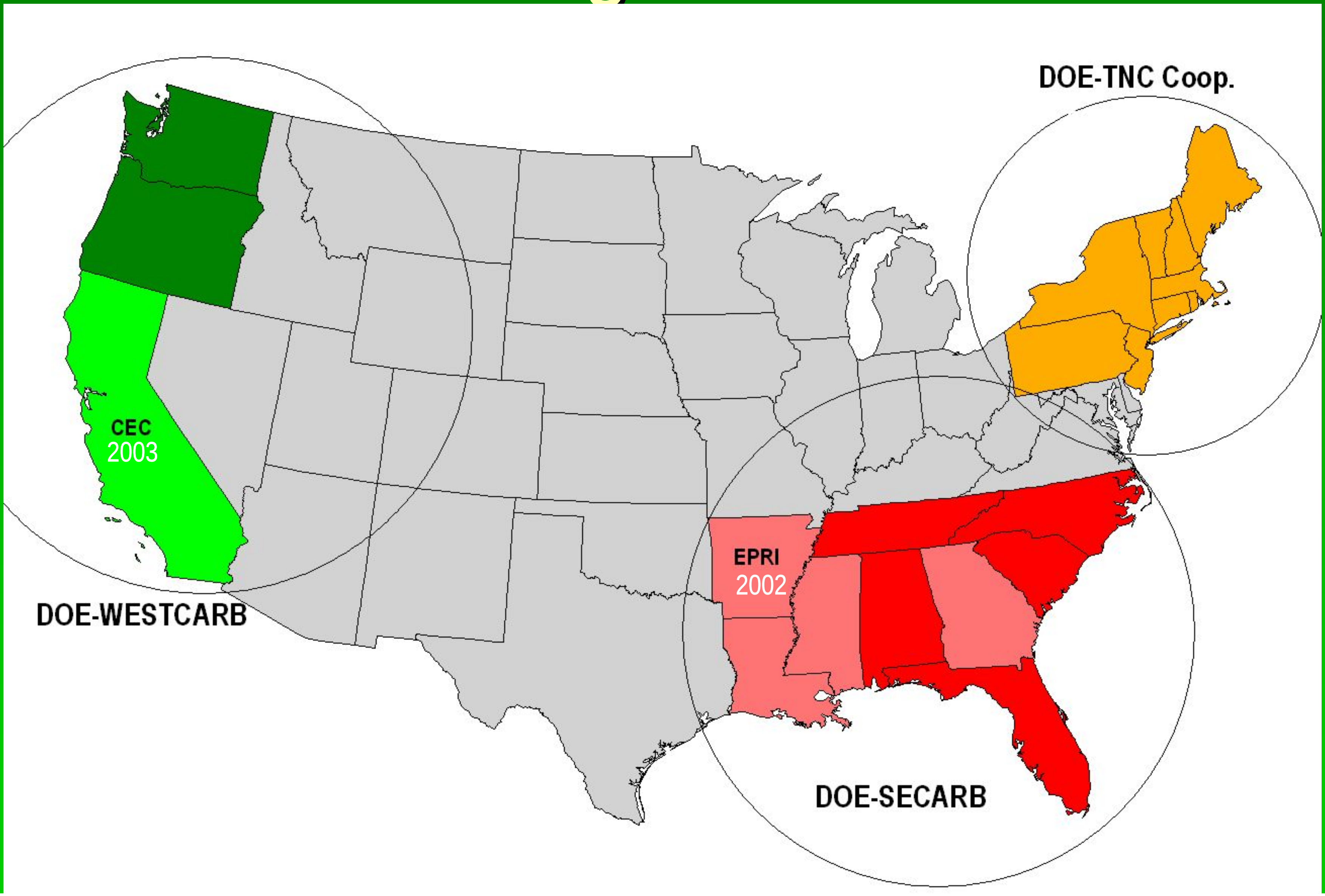
Energy security—where are sources of new biomass?

Link between understanding biomass resource availability and terrestrial carbon sequestration

Linking biomass availability and carbon sequestration, the key question is…..

- What amount of new biomass carbon is available and where from changing land use and management practices at <u>what price</u>?
  - Goes beyond just technical potential—also includes economic potential

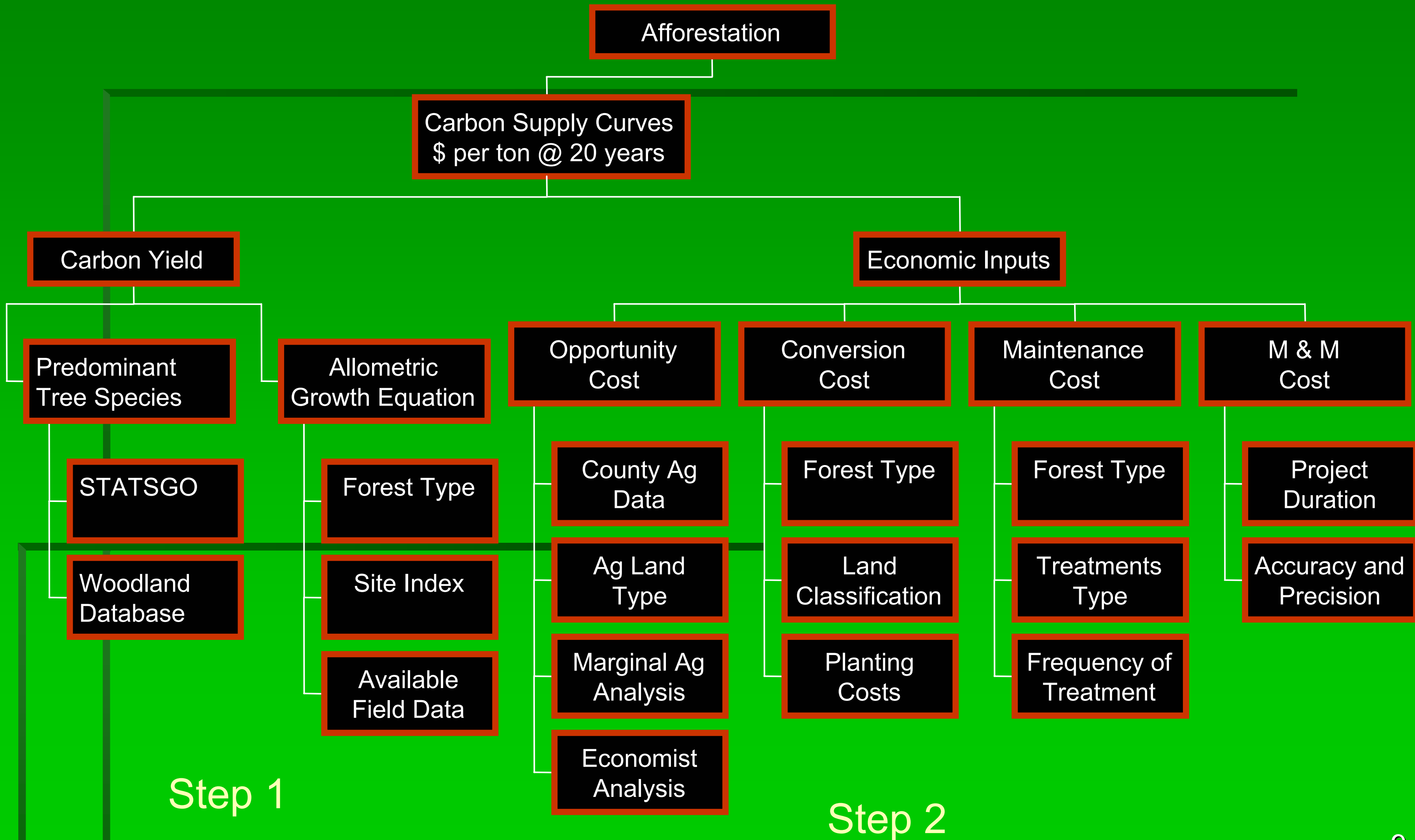
Regional carbon supply analyses for afforestation of agricultural lands



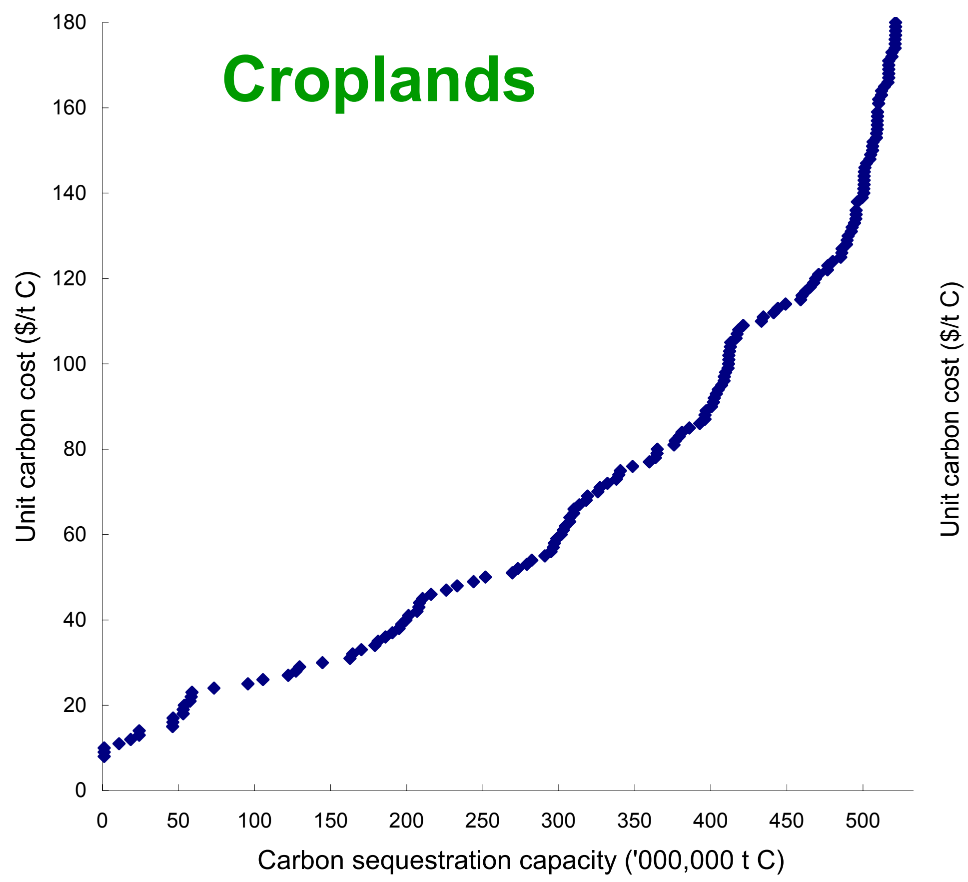
Overall approach

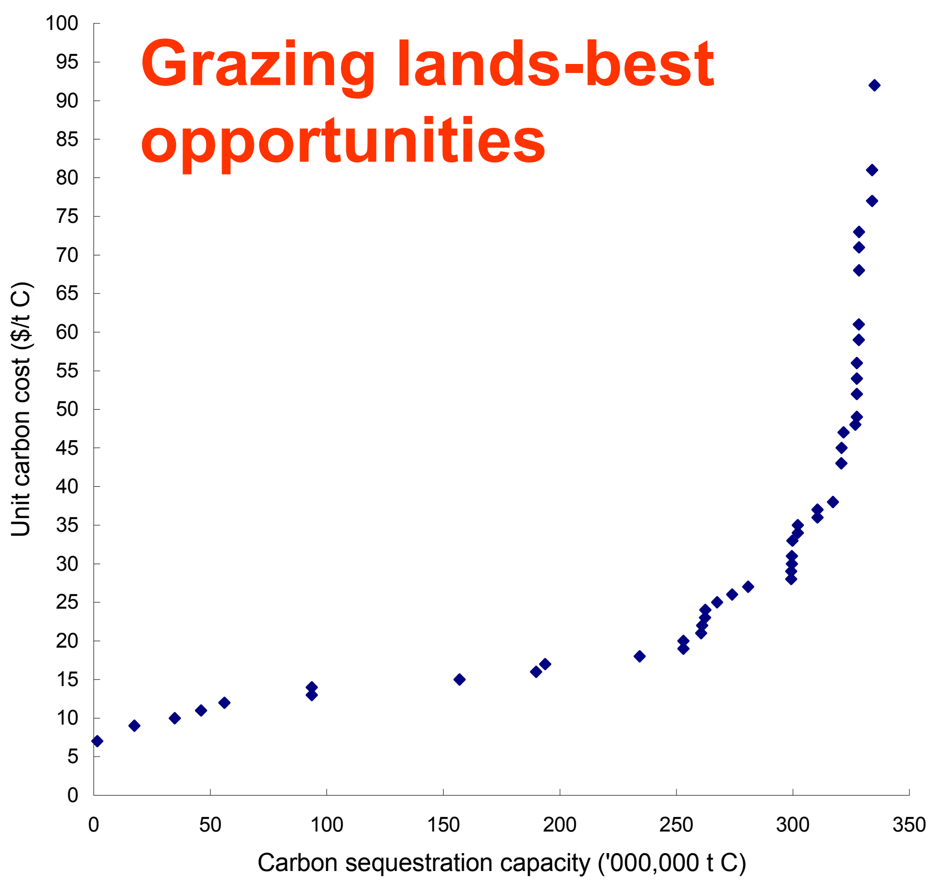
- Identify and locate land classes suitable for increasing carbon stocks
- Estimate rates of carbon accumulation for afforestation for each land class,
- Assign values to each contributing cost factor
- Perform analyses in a geographic information system (GIS) to include the diversity of land uses, rates of carbon sequestration, and costs in the analyses

Approach for estimating carbon yield & costs for afforestation of crop and grazing lands



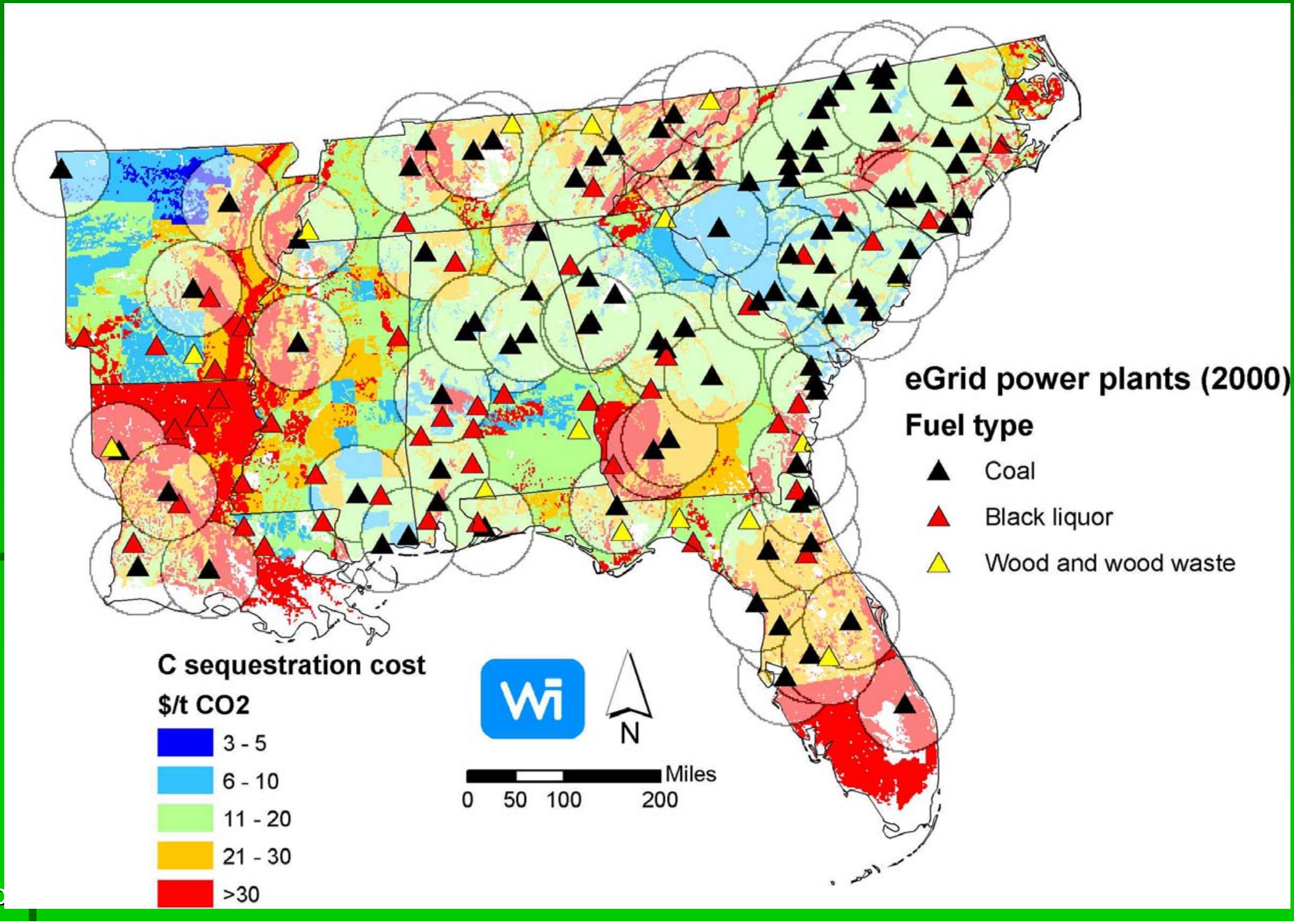
Total carbon supply for afforestation after 20 years





Note differences in cost scale

Potential carbon supply in relation to existing power plants—potential to co-fire



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How to link the carbon sequestration potential to a power plant site?

- Link coal-fired power plants with the most attractive terrestrial carbon sequestration opportunities
  - Plant life extension
  - Cost of biomass fuel and carbon credits
  - Potential co-benefits
- Identify locations for new biomass energy plants based on availability of cost-effective potential biomass carbon supply
- Link biomass fuel purchase with terrestrial sequestration credits

Healthy Forest Initiative

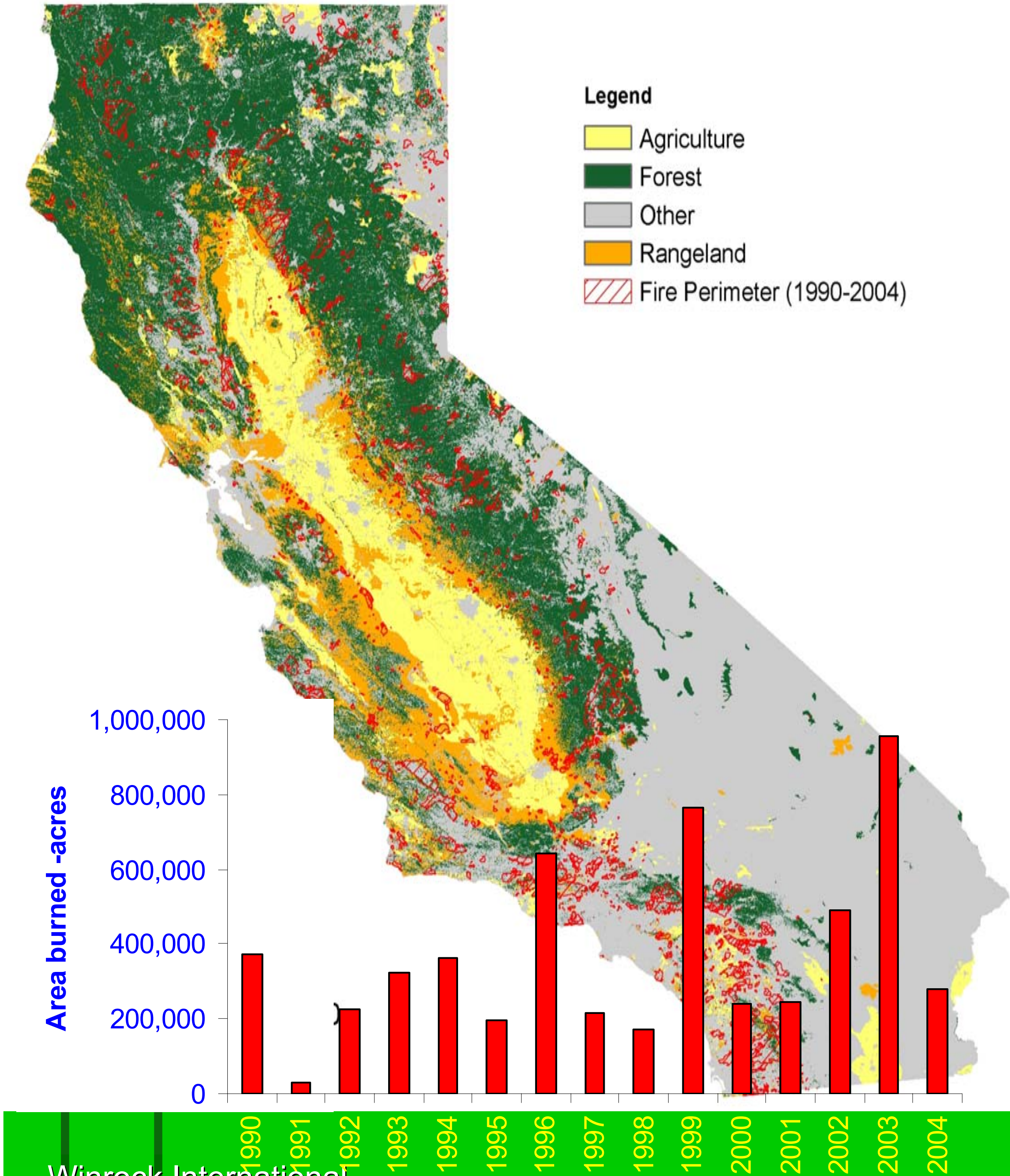
Reduce hazardous fuel to reduce severity of wildfires

Potential sequestration benefits from improved fuels and fire management

Source: Sandberg, USDA Forest Service

- Reduce GHG emissions from loss of carbon stocks
- Reduce area burned
- Reduce fire severity
- Bring fire to the ground
- Increase growth rates in residual stand
- Decrease costs of fire fighting
- Provide source of biomass energy to offset fossil-fuel emissions

Fires in California



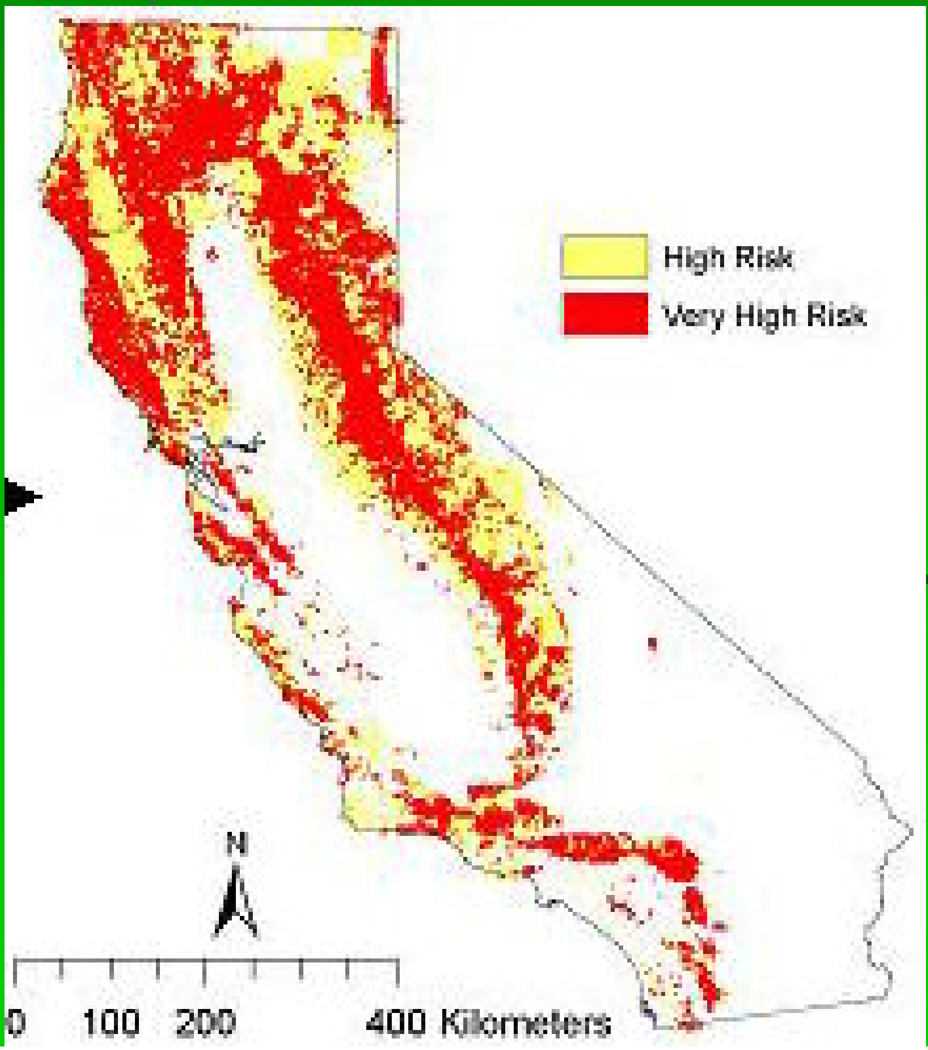
Total area burned in 1990-2004 = 5.5 million acres

Emissions from fires during period ~ 26 MMT CO_2 plus other GHGs

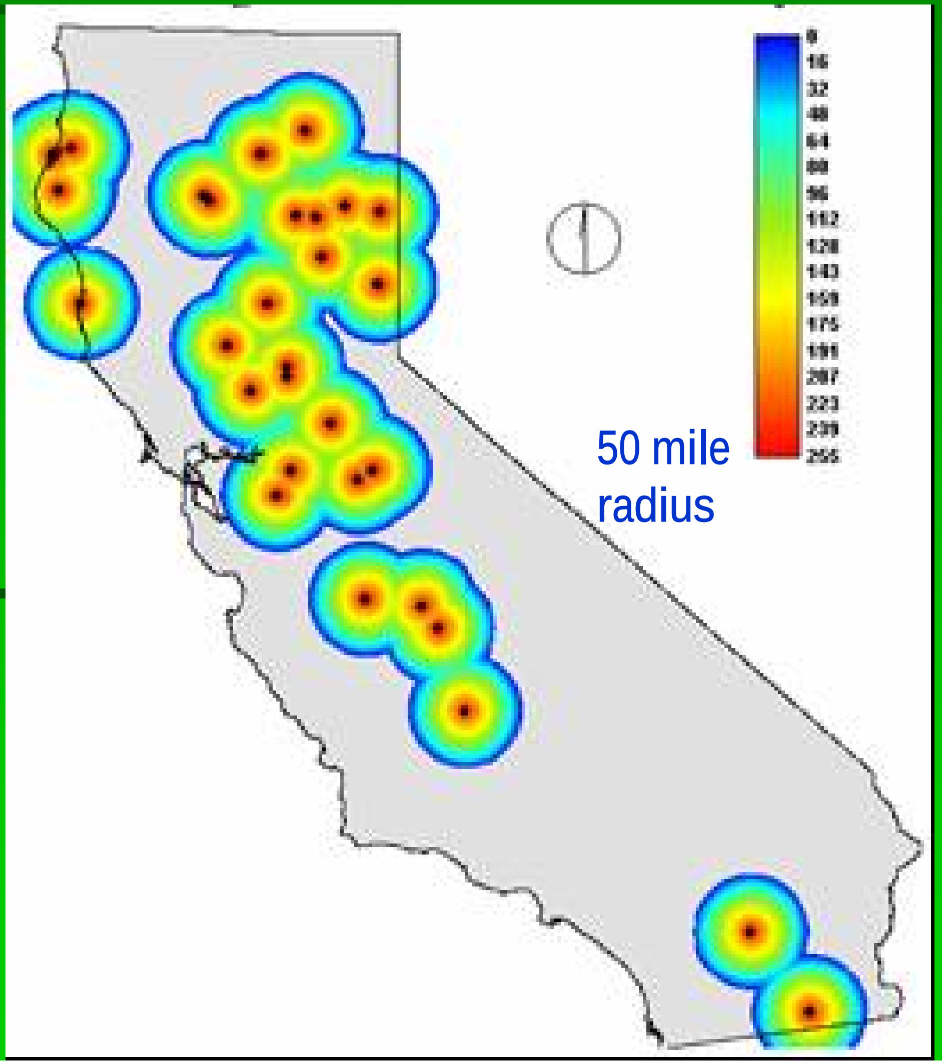
Costs of fighting increasing –more than $1 billion for country

Which forests can be treated for fuel reduction?

1. Forests at risk for fire based on fuel ranking



2. Locations of operational biomass power plants



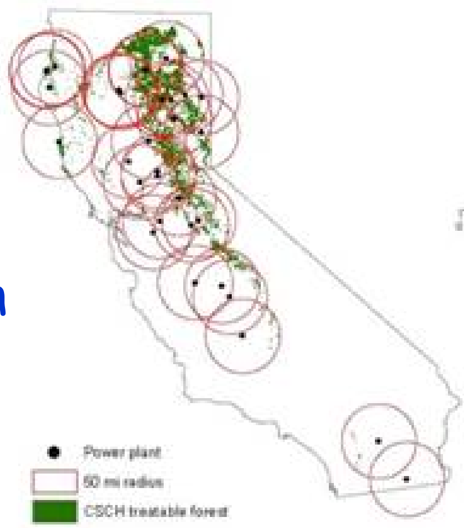
How practical is forest fuel removal for reducing fire intensity and generating biomass for power plants?

- Asses the area of forests with high to very high risk for fire:
  - used a common fuel treatment of Cut, Skid, Chip and Haul (CSCH),
  - how much biomass fuel this might generate for use in power plants,
  - and at what cost

Areas of forest at risk suited for CSCH treatment

A – Slope factor   B – Yarding distance factor   C – 50 mi haul distance factor

1.51 million acres treatable (9% of forests at risk) & contain 108 million tons biomass



D – Minimum block size factor

-Removing 10 dry tons per acre provides 15 million tons of biomass for power plants.
-30 MW plant with 80% reliability would require about 250,000 BDT/ year

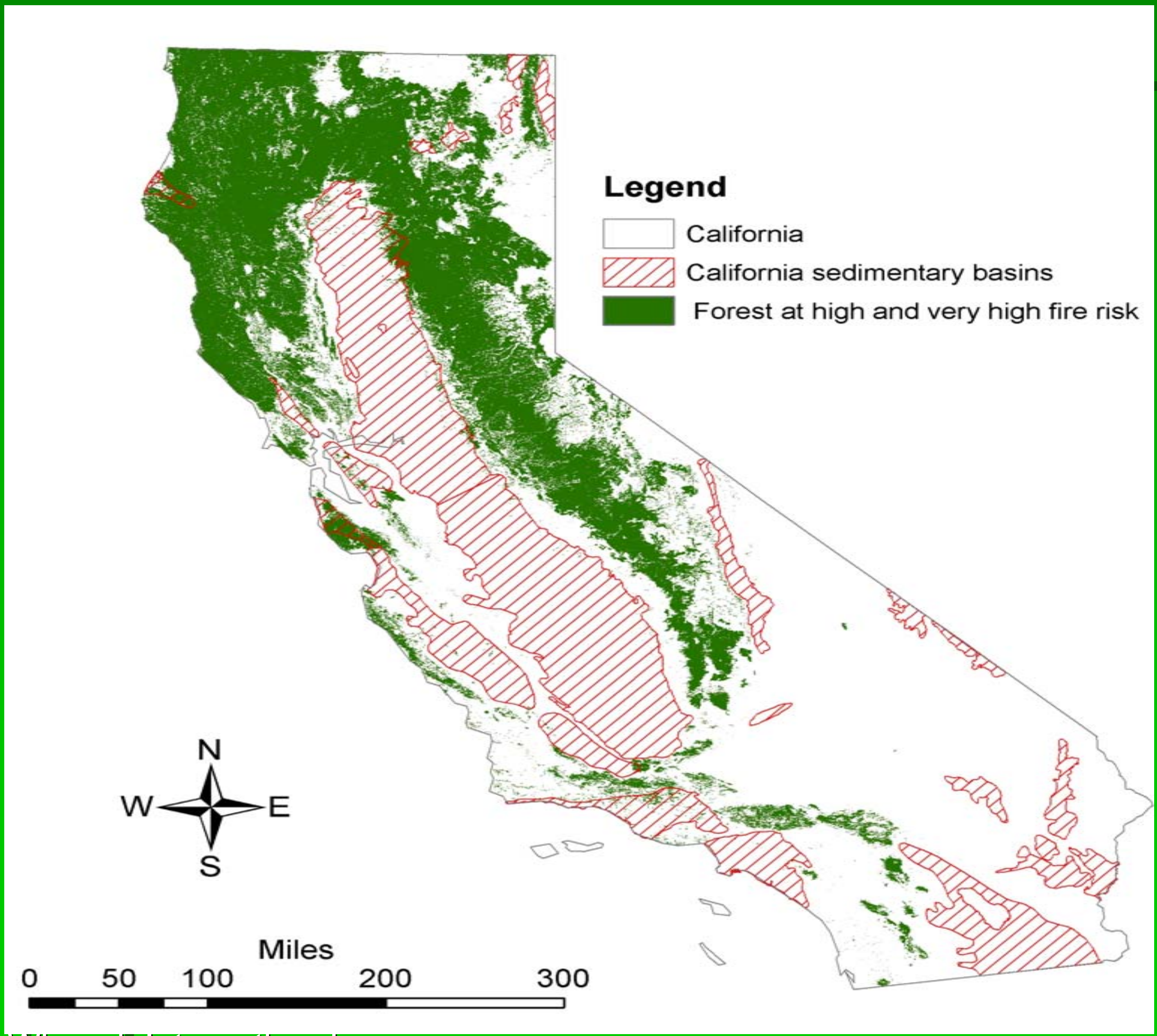
Does hazardous fuel removal make economic sense for carbon offsets?

- Assume cost of CSCH = $48/BDT removed; cost to remove 15 million BDT =$720 million
- Assume purchase price of fuel by energy plant = $36/BDT; total cost to buy =$540 million
- Thus $180 million needed to break even

Does hazardous fuel removal make economic sense? Cont….

- To treat the 1.5 million acres, subsidy required is equivalent to $119/acre to break even
- At common price of carbon offsets of $10/t CO_2, —need to reduce CO_2 emissions from wildfires by 12 t CO_2/acre
- Difference in CO_2 emissions between high and low intensity forest fires in CA is 40 to >100 t CO_2/acre
- The range of values in emissions reductions from fuel removals appears to be within the realm of practicality to cover costs needed for HFR.

Linking terrestrial with geologic sequestration



- Reduces emissions from biomass substitution
- Removes CO_2 from the atmosphere

Challenges for linking carbon benefits to healthy forest initiative

- Needs further research, including collection of additional data on other fuel treatments, emissions from wildfires of varying severity, baselines, and complete economic analyses
- Need to develop M&M protocols for quantifying the carbon benefits from HFR, including direct effects on forest and benefits from substitution of biomass for fossil fuel
- Assess annual sustainable delivery rates
- Identify potential locations of new power plants in relation to geologic sinks
- Assess socioeconomic and environmental co-benefits

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